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REMARKS

The Applicant appreciates the thorough review of the application by the Examiner. Reconsideration and allowance are requested.

The claims have been amended to overcome Examiner's rejections based on 35 U.S.C. 112, second paragraph.

No new matter has been added by the amendments. No new issues are raised by the amendments.

Claim 1 is patentable under 35 U.S.C. 102(b) over Hodgetts (U.S. Patent No. 5,697,109).

Claim 1 distinguishes the invention by providing an aid to turn persons lying in a bed as a single unit. Hodgetts discloses "an apparatus for transporting a patient that includes a base, a patient supporting member attached to the base, a conveyor removably secured to the base." This is a functional and structural difference between Hodgetts' disclosure and Applicant's invention. As pointed out in the specification, motivation for the present invention included not only turning persons in a bed, but turning persons on an operating table, where there is little room. The tiny confines of an operating room could hardly handle both the bed and patient conveyor of Hodgetts. Thus, Applicant's invention offers not just a difference in function (transporting versus turning) but also a structural difference (a single unit versus a base and conveyor).

Claim 1 is patentable under 35 U.S.C. 102(b) over Fregni (EPO Patent No. 374,784)

Claim 1 distinguishes Applicant's invention by providing a method of turning a patient in a standard bed with modifications. Claim 1 also distinguishes Applicant's invention by providing means of turning the person without the lifting or lowering of the mattress. Fregni's apparatus is

PAGE 8/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):08-42

an entirely separate bed that must have two separate rollers and four supports to lift the patient entirely off the specially built platform before moving the patient (see Fregni, Figure 4). This is structurally different from Applicant's invention, which can use a single roller attached to side of a standard bed and can rotate a person without lifting, which might be impossible in some of the motivating scenarios listed in the specification, such as in an emergency room.

Claim 3 is patentable under 35 U.S.C. 103(a) over Fregni (EPO Patent No. 374,784).

Claim 3 is dependent on patentable independent claim 1. Claims 3 adds patentable features to the patentable features of claim 1. The subject matter of the claims would not have been obvious at the time the invention was made to a person having ordinary skills in the art. Claim 1 is patentable over Fregni as described above. There would have been no motivation to combine the references.

Fregni specifically discloses a motor external to the roller (see motor 36 in Figure 2 of Fregni). Furthermore, Applicant traverses Examiner's holding that "[i]t would have been obvious for one having ordinary skill in the art at the time of the invention to employ gears." Fregni's device involves quickly sliding fabric between two rollers. There is no motivation found in Fregni's disclosure for using gearts and further, precise adjustment of Fregni's device is unnecessary and non-obvious.

Claims 2, 4 - 8, and 10 are patentable under 35 U.S.C. 103(a) over Hodgetts (U.S. Patent No. 5,697,109) in view of Knouse (U.S. Patent No. 4,747,170).

Claims 2, 4 - 8, and 10 are dependent on patentable independent claim 1. Claims 2, 4 - 8, and 10 add patentable features to the patentable features of claim 1. The subject matter of the

PAGE 9/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):06-42

claims would not have been obvious at the time the invention was made to a person having ordinary skills in the art. Claim 1 is patentable over Hodgetts as described above. There would have been no motivation to combine the references.

There is no motivation to combine Hodgetts and Knouse. Nothing in Hodgetts suggests the use of a geared reduction box. There would be no motivation to combine the two as they cannot possibly be combined. Hodgetts discloses an apparatus that attaches to the side of a bed and works in conjunction with a conveyor. Knouse on the other hand is a portable device that is used to drag patients from one surface to another. Combining the two would either destroy the portability aspect of Knouse or cause the problems associated with a non-attached roller as described in Hodgetts (Column 1, lines 55-67).

As to Claims 2 and 4, these claims depend from claim 1, which as noted above, is not disclosed in Hodgetts.

Claim 5 distinguishes Applicants invention by providing a step-motor at the free end of the roller. Applicant traverses Examiner's holding that "a step motor and electric motor are equivalent means" without citing art. As disclosed in the attached exhibit and in the specification, an electric step motor allows for precise control of the position of the motor and can be held in any fixed position, as well as rotating one way or the other. Step motors are functionally and structurally different from common electric motors.

Claim 6 distinguishes Applicant's invention by providing the holder means adapted and interacting with the long side of the bed or its under frame. Hodgetts does not disclose this feature. Hodgetts only discloses his device as attached to the upper portion of the bed. In fact, Hodgetts specifically discloses that his apparatus is attached to head and base board of the bed.

PAGE 10/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):06-42

See Col 5, lines 19-32. None of Hodgetts figures disclose the apparatus located beneath the frame.

Claim 7 distinguishes by placing the apparatus beneath the bed frame and allowing the roller to pivot only within an acute angle in relation to vertical. Hodgetts does not disclose this. Hodgetts' apparatus is never beneath the bed frame and his apparatus is for moving patients between a bed and gurney by rolling bed sheets. His apparatus requires several complete revolutions of the roller to accomplish his goal of transferring patients while Applicant's invention is related to turning patients within a bed.

Claim 8 distinguishes the invention by providing a convenient method of attaching sheets to the roller not found in Hodgetts. Hodgetts' apparatus includes attaching the sheet using adhesive tape. There are many benefits to using the different means of attaching sheets such as those listed her.

Claim 10 distinguishes the invention by providing sliding guideways. Examiner cites no specific portion of Hodgetts as disclosing guideways. Indeed, Hodgetts discloses two methods of attaching his apparatus to a bed: (1) by permanently welding or bolting or (2) attaching a bracket using wing nuts. See Col. 5, lines 15-45. As noted in the Specification, sliding guideways provide a standardization feature not found in the prior art.

Claims 9 and 11 are patentable under 35 U.S.C. 103(a) over Hodgetts (U.S. Patent No. 5,697,109) in view of Knouse (U.S. Patent 4,747,170) and further in view of Fregni (EPO Patent No. 374,784).

Claims 9 and 11 are dependent on patentable independent claim 1. Claims 9 and 11 add further patentable features to the patentable features of claim 1. The subject matter of the claims

PAGE 11/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):06-42

would not have been obvious at the time the invention was made to a person having ordinary skills in the art. Claim 1 is patentable over Hodgetts and Knouse as described above. There would have been no motivation to combine the references.

As noted above, Hodgetts and Knouse cannot be combined without destroying important aspects of each. It would have been completely impossible to combine Hodgetts, Knouse, and Fregni together. Fregni teaches an apparatus built into four supports of a bed that raise a person up while adjusting their position. Hodgetts teaches a roller attached to the side of a bedframe and Knouse teaches a portable patient mover. It would be physically impossible to combine these three completely diverse apparatuses. The support lifters in Fregni could not possibly be made to work in either the portable Knouse or the bedside apparatus of Hodgetts.

PAGE 12/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):06-42

CONCLUSION

Reconsideration and allowance are respectfully requested.

Respectfully,

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PAGE 13/17 * RCVD AT 7/24/2006 4:48:49 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-2/16 * DNIS:2738300 * CSID:703 448 7397 * DURATION (mm-ss):06-42

Control of Stepping Motors

A Tutorial

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This material expands on material originally posted to the rec.railroad newsgroup in 1990. Significant parts of this material have been republished as sections 5.2.10, 10.8, 10.9 and 10.10 of the *Handbook of Small Electric Motors* edited by W. H. Yeadon and A. W. Yeadon, McGraw-Hill, 2001.

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Index

- Abstract
- Introduction
- 1. Types of Stepping Motors
- 2. Stepping Motor Physics
- 3. Basic Control Circuits
- 4. Current Limiting
- 5. Microstepping
- 6. Mid-Level Control
- 7. High Level Real-Time Control
- old 5. Stepping Motor Control Software
- old 6. A Worked Example
- Other Sources of Information

Abstract

This tutorial covers the basic principles of stepping motors and stepping motor control systems, including both the physics of steppers, the electronics of the basic control systems, and software architectures appropriate for motor control.

Introduction

Stepping motors can be viewed as electric motors without commutators. Typically, all windings in the motor are part of the stator, and the rotor is either a permanent magnet or, in the case of variable reluctance motors, a toothed block of some magnetically soft material. All of the commutation must be handled externally by the motor controller, and typically, the motors and controllers are designed so that the motor may be held in any fixed position as well as being rotated one way or the other. Most steppers, as they are also known, can be stepped at

audio frequencies, allowing them to spin quite quickly, and with an appropriate controller, they may be started and stopped "on a dime" at controlled orientations.

For some applications, there is a choice between using servomotors and stepping motors. Both types of motors offer similar opportunities for precise positioning, but they differ in a number of ways. Servomotors require analog feedback control systems of some type. Typically, this involves a potentiometer to provide feedback about the rotor position, and some mix of circuitry to drive a current through the motor inversely proportional to the difference between the desired position and the current position.

In making a choice between steppers and servos, a number of issues must be considered; which of these will matter depends on the application. For example, the repeatability of positioning done with a stepping motor depends on the geometry of the motor rotor, while the repeatability of positioning done with a servomotor generally depends on the stability of the potentiometer and other analog components in the feedback circuit.

Stepping motors can be used in simple open-loop control systems; these are generally adequate for systems that operate at low accelerations with static loads, but closed loop control may be essential for high accelerations, particularly if they involve variable loads. If a stepper in an open-loop control system is overtorqued, all knowledge of rotor position is lost and the system must be reinitialized; servomotors are not subject to this problem.

Stepping motors are known in German as *Schrittmotoren*, in French as *moteurs pas à pas*, and in Spanish as *motor paso paso*.

Other Sources of Information

Web Sites

Other Motor Control Web Pages

- Advanced Micro Systems Stepper Motor Basics
  an excellent tutorial from a maker of motors and controllers.
- motioncontrol.com
  a commercially operated gateway to motion control resources on the web
- Ian Harries on Stepping Motors
  with a nice set of information on reverse engineering salvaged motors and a number of example applications.
- Euclid Research MotionScope demo
  excellent illustrations of physical behavior of some real motors.

Motor Manufacturers

- Advanced Micro Systems (1.8 degree per step, large permanent magnet motors)
- Astrosyn. (UK)
- Donovan Micro-Tek Inc. (very small motors)
- Eastern Air Devices Inc. (midsize motors and linear actuators)
- MyMotors & Actuators The Faulhaber Group (very small pancake-format motors)
- Gunda Electronic GmbH (German) (Google's English translation)
- Haydon Switch and Instrument, Inc.

- IntelLiDrives (high-resolution linear and 2-d planar stepping motors)
- Lin Engineering (100 to 800 steps per revolution)
- MicroMo Electronics (very small motors)
- Mitsumi (Japan)
- Phytron, Inc. (motors and controllers)
- Portescap Inc.
- Shinano Kenshi Corp. (SKC)
- Micro Precision Systems (remarkably small motors and controllers)

Controllers

- Advanced Micro Systems
- Astrosyn. (UK)
- Advanced Micro Systems Inc.
- Alzanti Limited (UK)
- Arrick Robotics
- Control Technology Corporation
- E-Lab Digital Engineering, Inc.
- GreenSpring Computers
- Simple Step LLC
- Netmotion
- StepperControl.com

Distributors

- ACP&D Limited (UK) (UK version) (distributor for COLIBRI integrated motor/controllers and maker of COBRA linear and planar stepping motors)
- Alzanti Limited (UK)
- Electro Sales Inc. (northeast USA)
- Flexible Technologies, Inc. (Southwest USA)
- MESA Systems Co. (USA) (distributor for COLIBRI integrated motor/controllers)
- Motionex (southeast USA)
- Smart Motion Control Inc. dba ABC Motion Control (northeast USA)
- Technovation Systems Ltd. (UK)

Surplus and Hobbyist Suppliers

- ALL Electronics (new and surplus)
- DIY Electronics (kits, Hong Kong)
- EIO's Stepper Motor Page (surplus)
- PC Gadgets (the Gadgetmaster interface)
- Hi-Tech Surplus
- Surplus Center (mostly heavy industrial surplus, Nebraska)
- Vorlac (Surplus, australia)
- Wirz Electronics (Hobbyist oriented, controllers)

Motor Design, Selection and Prototype Fabricaton Services

- Yeadon Engineering Services, yes@up.net (Michigan)
  YES is the contact for the Small Motor Manufacturer's Association.

Jones on Stepping Motors

Other Web Pages

- The Art of Motion Control;
  Bruce Shapiro's stepper-controlled machine-shop and artist's studio.
- EIO's Stepper Motor Page;
  a surplus dealer, but listed here because of their extensive index of information about stepping motors.
- Fractional Horsepower Motor Manufacturers;
  an index maintained by Industrial Quick Search.
- Schmitz Engineering Liaison;
  a rotary shaft position encoder distributor offering consulting services on encoder use. Roger Schmitz wrote Encoder Output Choices for System Designers for MOTION Magazine.

Books

Handbook of Small Electric Motors
William H. Yeadon and Alan W, Yeadon, eds.
McGraw-Hill, c2001.
LC number: TK2537 .H34 2001

Stepping motors: a guide to modern theory and practice
Acarnley, P. P.
P. Peregrinus on behalf of the IEE, 1984, c1982.
LC number: TK2537 .A28 1984
A third edition has recently been released.

Stepping motors and their microprocessor controls
Kenjo, Takashi
Oxford University Press, c1984.
LC number: TK2785 .K4 1984

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